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Video in Education: A Practical Guide for Teachers

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Abstract

The tools available for teachers to integrate technology into the curriculum can be overwhelming. Revisit a tried and true technology, video, which has been upgraded for the digital age. Video is a highly motivating medium for middle school students, especially when they are allowed to film their own movies. A discussion of research based methods for effectively using video in the classroom is followed by ideas and resources for creating movies to use with students.

Introduction

With the pervasiveness of the Internet both in the classroom and in student's personal lives, along with calls to integrate technology from the No Child Left Behind (NCLB) legislation and the National Education Technology Standards (NETS), teachers are pressured to find effective and efficient strategies for integrating technology and online resources into the curriculum. However, without the time and money for training, many schools find it difficult to support teachers in incorporating these resources successfully. One solution is a return to a technology that many teachers are already comfortable with - video. Access to a variety of video resources via the Internet and DVDs makes it easier than ever for bringing video back into the classroom.

Video in the Classroom

Reasons for using video in the classroom vary from the practical to the pedagogical. Time and money limit the number of field trips schools can offer and

time travel is impossible, however video can help to take students anywhere and anytime. Video can also present material with which the teacher may not be completely comfortable. On the other hand, the true value of video is in its potential to increase learning. Lankford (1992) claims, "Tying emotions to the learning experience increases retention of the learning," and he adds, "The teacher's real challenge in using film or video is to ensure that the students experience the emotional impact." (p. 1).

Growing up in the digital age, today's students are much more comfortable than their parents or teachers with gathering information from a variety of mediums. Valmont (1995) proposes that students' "cognitive learning styles and information processing abilities might be heavily influenced by exposure to the massive visual information offered by television and video" (p. 12). Why not harness this visual information for use in the classroom? After all, twenty years ago we could not imagine the influence the Internet would have on our daily lives. We have only to look at the pervasiveness of the Internet and cell phones to realize how our students will be communicating differently in the future. The question for teachers is how to prepare students for this visual future. Students will need to be visually as well as verbally literate.

Visual literacy is the ability to appreciate, interpret, evaluate, and analyze visual communications of all kinds (Lankford, 1992). However, visual and verbal literacy work together. In Collins' (1997) discussion of visual literacy, she points out that we are not moving away from verbal literacy towards visual literacy, but towards a "world of multimodality" where pictures and words work together. We use both words and pictures in all content areas: graphs in math, diagrams in science, and photographs of far away cultures in social studies. It is only a matter of time before video becomes a common tool for describing and analyzing a variety of concepts. It is important to prepare our students to be critical viewers as well as critical readers.

This idea that pictures and particularly video or film has its own language or ways of communicating is inherent to the study of symbol systems. Gavriel Salomon (1979) laid the groundwork for the study of media in terms of symbols. He claimed that all media is made of symbols inherent to that media. For example, print media uses paragraphs, sentences, and punctuation to convey content to the reader. Film or video has its own symbology such as the framing and order of shots, zoom and pan, and other devices to convey content to the viewer. Salomon admits that different subject matter, contexts, and learners can benefit differently from the use of these symbols, and his research probes the ways in which students and other viewers learn from the symbology of video media. What is most important, however, is that the unique symbology of video has the potential to increase learning if used correctly.

Another factor in the effectiveness of video is how it grabs the attention of the student and promotes comprehension. Observations of students watching television indicate that attention is intermittent although students continuously monitor programs on some auditory or visual level. Initially, watching a video was seen as a passive activity. The object was to capture the viewer's attention and then it was thought that the viewer would simply comprehend and retain all information presented. In effect the television controlled the viewer. Newer, active theories assume the viewer plays an active role by examining, filtering, and processing what is presented. This idea of intense visual attention depends on the meaningfulness of the content (Anderson & Lorch, 1983).

If teachers can aid students in the monitoring, filtering, and processing of visual information, comprehension and retention of information presented through video will increase. Salomon (1981) created a term for this, AIME, or Amount of Invested Mental Effort, in which learning does not occur unless viewers are actively thinking as they watch a video or television program. For example, studies from the 1950s have shown that activities as simple as having students recite phrases along with a narrator or respond to questions embedded in a video can dramatically increase retention (May et al., 1958).

Specific properties of video, particularly on DVD, CD, or the Internet, can be exploited to enable active viewing by students. Video may be stopped and started to enable discussion and speculation. It can also be easily replayed, slowed down, or sped up to reinforce concepts that may be difficult to understand. Most importantly, because video consists of auditory and visual information that is usually conveyed concurrently, students have multiple opportunities to process information. Studies show that optimal learning occurs when verbal and visual information is presented simultaneously (Wetzel, 1994).

So how does all of this translate to the classroom? Video is only as effective as the manner in which it is used to teach. In fact, "differences between media may be less important than the teaching methods used within a medium" (Wetzel, 1994, p. 10). This paper offers specific, concrete strategies for improving the value of video as an instructional tool particularly for students with lower abilities or limited prior knowledge.

As early as the 1940s when film was first being used as an educational tool, the ability to pause a film to ask questions and spur discussion was seen as a means to increase motivation and participation. A Yale study commissioned by the Motion Picture Association of America to evaluate teaching films found that splicing questions into a film to focus student attention produced an average increase in post-test performance of over 10% (May, 1958). A similar study

conducted in 1994 looked at high school chemistry students viewing a set of 30-minute videos over the course of the school year. In the group in which the video was stopped every 5-7 minutes for questions and class discussion, performance on the end of year achievement test was 20% higher than for the control group in which the video was shown without interruption (Harwood, 1997). One participant's reaction to the study was quite compelling:

> When I know she [the teacher] is going to stop the tape, then I know I am supposed to be listening for stuff and that she will ask questions. It's not like I have to watch this tape for the whole period and then I find out that I didn't even get the point. When my teacher stops the video she asks questions, and if no one knows the answer, she rewinds the tape and we listen again. It takes some getting used to, but at least you learn that way (Harrwood, 1997, p. 628).

Using video purposefully not only draws student attention to important information and concepts, it also models visual literacy so that over time students become more critical and efficient consumers of visual material.

Student achievement through the use of video can also be improved by teacher introductions and class preparation. Teaching strategies include identifying portions of the video that may be difficult to understand, listing points to look for, and presenting a brief summary of the video before viewing. In fact, "teacher directed reviews and summaries following the film have also been found to be about as effective as introductions, and in some cases, were more effective than a second showing of the film" (Wetzel, 1994, p. 22). Even the placement of the video within a unit of study can affect how much students learn from the experience. May (1958) found that when a film is shown to introduce a topic, it is far less effective in increasing student understanding than when it is shown as a review at the end of a unit.

Lankford (1992) suggests using only specific elements of video such as viewing the video without audio and asking students to describe what they see or think is happening before viewing the video with sound or narration. It is effective to stop the video often to discuss and clarify points or to show only the portion of the video that is relevant to the lesson. It may also be useful to show more than one video on the same topic for comparison. Other important teaching considerations when using video include reducing visual or audio distractions and refraining from asking students to take notes as this can detract from their processing of the information and concepts presented (Wetzel, 1994; Valmont, 1995).

The strategies described above can be applied regardless of content area or age

group. Other uses for video are more subject matter specific and samples are summarized in the table below (Herrell et al., 1998).

Subject	Strategy	Description
Language Arts	Vocabulary and Description	Show a brief video clip of an action or object and ask students to describe and write stories to explain the situation.
	Story Simulations	Videotape students reenacting literature, including writing the script, storyboarding, acting, and producing.
Science and Math	Microscopes and Telescopes	Adaptors can be purchased to allow taping through a microscope or telescope so it is easier for an entire class to see.
	Laboratory Safety	Create or purchase a video on the basics of lab safety along with the use, care, and storage of materials. Show the video at the beginning of the school year and periodically throughout the year to remind students of safety procedures.
	Nature Study	Many processes in nature take time or occur outside of school hours, but with the use of a video camera these events can be recorded and time enhanced.
	Practical Applications	In science and math it is important to make connections between content and real-world applications. Viewing tapes of various professions and the uses of math and science can help students make connections, or better yet, have students make their own tapes.
Social Studies	Critical Thinking Skills	Showing clips of the same events reported on different newscasts can bring up issues of bias, points of view, and objectivity that are important aspects of critical thought.
	Using Resources	Before students visit out of school resources such as historical societies, archives, or college libraries, create a video orientation of the facility including what rules to know, where to go, and who to ask.
All Areas	Guest Speakers	Videotape guest speakers to share the experience with other classes and to archive.

	Parent Teacher Conferences	Videotaping an ordinary class period on a periodic basis can provide parents with unbiased glimpses at how their child performs in class.

All of these methods for integrating video into the curriculum can be applied to commercially produced videos as well as videos you create yourself. In fact, in many situations it may be easier or more relevant for you and/or your students to create a video to use in class. The following section describes the equipment and steps necessary for creating quality classroom video.

Creating Your Own Video

In *Shadow of the Vampire* Cage (2000) talks about the value of video to memory:

> Our battle, our struggle, is to create art. Our weapon is the moving picture. Because we have the moving picture, our paintings will grow and recede; our poetry will be shadows that lengthen and conceal; our light will play across living faces that laugh and agonize; and our music will linger and finally overwhelm, because it will have a context as certain as the grave. We are scientists engaged in the creation of memory... but our memory will neither blur nor fade.

Educational digital video memories may not blur or fade but they are certainly subject to compression artifacts and may take days to download. Below are guidelines for creating video that will perhaps reduce some issues with digital video.

Equipment

The most basic essentials for shooting video include a camera, tripod, microphone, and lights.

Camera

When considering the purchase of a new camera it is important to understand the different types that are available. The type of camera will depend on the subject as well as intended use of the film and how it will be edited.

Digital cameras encode the data they collect (audio and video) as a discrete series of 0s and 1s on magnetic tape. This makes it easier to capture the video to a computer without loss of quality. Digital cameras are generally more expensive than analog cameras but produce a higher image quality. The four main types of digital camera available today, in decreasing order of quality and cost include

MiniDV, Digital8, MicroMV, and web cameras (or webcams). Although webcams are not often considered because of low image quality, they are affordable and can record directly to a computer via a USB serial port (Click and Go Video, 2002). Analog cameras record video and audio data as a continuously varying waveform which makes for a smoother picture. However, loss of quality occurs during download to a computer for editing. Analog cameras in general are larger and cheaper than digital cameras. There are three main types of analog cameras: VHS with tapes that can be played in a video cassette recorder (VCR), Standard 8, and Hi8 which is just an enhanced version of Standard 8 and uses the same tapes as Digital8 cameras (*Click and Go Video*, 2002; Martindale, 2002).Another consideration is the method for connecting a camera to computer. The most efficient means, particularly for digital cameras, is IEEE audio input and output. Common trade names for IEEE are FireWire (by Apple) and iLink (by Sony). The advantage of FireWire is that video can be captured to a computer in real time with perfect synchronization between video and audio. Most computers now feature a FireWire port although many cameras will also connect via USB serial port (Martindale, 2002).

Other features to look for in a video camera are the number of charge-coupled devices (CCDs) and zoom. CCDs are computer chips that convert light coming into the camera into digital signals and are only found on digital cameras. The number of CCDs varies from one to three and will largely determine the quality and cost of a camera. The amount of zoom may also be important. Optical zoom is true zoom that uses the lenses on the camera to make the image appear larger while digital zoom merely enlarges the pixels and can make an image appear boxy (Martindale, 2002).

Tripod

The most important piece of equipment besides the camera is a tripod. A tripod alone can make the difference between an amateur home video and one of semi-professional quality. A tripod is crucial for reducing the amount of shaking and other unnecessary movement of the camera. This can be critical for encoding any video to be delivered over the web. A tripod should provide smooth panning (side to side motion) and tilting (up and down motion) (Click and Go Video, 2002).

Microphones

Although cameras come with a built-in microphone, it would be wise to invest in an additional one. They are relatively inexpensive and can impact the quality of the film. Remember that only half of what is recorded is video; the rest is audio and should be considered just as important. While video can be tweaked for brightness and contrast, it is nearly impossible to improve bad audio. In fact, good audio can often make up for the shortcomings of bad video (Kelsey & Feeley, 2000).

Shotgun microphones can attach directly to your camera or to an arm that is carried separately. They are unidirectional, meaning they only collect sound coming from the direction they are pointed. Some shotgun microphones offer a zoom feature so that when the camera zooms in, the microphone also zooms into the same location. Shotgun mikes are useful for filming large group with multiple subjects, for interviewing in a controlled environment, or for controlling background noise.

A wireless microphone should be used to record interviews, guest speakers, or any situation involving a moving subject. Microphones can either be handheld, as those used by field reporters for news shows, or lavalieres which clip onto clothing. Most wireless microphones have a range of about 50 yards and have multiple channels to avoid interference from other sources. When using wireless microphones, be sure to use fresh batteries.

For all microphones it is essential that the camera operator wear earphones connected to the camera to monitor the sound. Otherwise, there is no way of knowing if the background noise is overpowering, a connection comes loose, or batteries have died until it is much too late.

Lights
There are several low cost alternatives to high-end lighting. The general rule is soft light is better than hard light. Avoid complex shadows, hotspots, and large contrast.

The easiest way to achieve soft light is to reflect a bright light or even sunlight off a diffuser. This can be a light umbrella, wall, or even a large piece of white poster board. Poster board or some other reflector can be used to redirect a strong overhead light such as room lighting or the sun at a subject so there are fewer strong shadows. Gooseneck lamps also work well. More tips on lighting will be provided in the Shooting Video section.

Planning and Pre-Production
All the equipment in the world cannot produce quality video without adequate planning. Some basic questions to consider when planning include: (1) Why do you want to use video? (2) Who is the target audience? (3) What are your objectives? That is, what do you want the audience to learn? (4) What are the best instructional methods to get these objectives across? (5) What are your budget and time constraints? (6) What equipment do you require? (Deal, 2003; Click and Go Video, 2002). A good resource for addressing these questions is the Click and Go Video (2002) Decision Tool (www.clickandgovideo.ac.uk). This

tool addresses pedagogical focus (image, interaction, or integration) as well as technical and implementation issues to help develop the most appropriate plan.

Next to consider is the script. A script answers the basic question, “What do you want to say?” This will help clarify the details of the video such as who is involved, where will you shoot, what props will you need, and how long will it take? Creating a script is also useful to accompany any video as a text alternative (Click and Go Video, 2002).

After a script it is important to create a storyboard or a list of shots, or video sequences. A storyboard addresses the question, “What do you want to show?” For a good idea of what a storyboard looks like, open any comic book. Each frame can be considered a shot where the action, dialogue, and characters are drawn in the order and location they are to appear. A detailed storyboard will help the filming process go smoothly, particularly if there are several people involved.

Next, plan the most efficient order for shooting. This may not necessarily be chronological or in the order of the final tape. Schedule plenty of time for shooting, at least twice as much as you think you will need. It is important not to feel rushed. Make arrangements well ahead of time with actors, crew, and interviewees (A. Foley, public presentation, Fall 2004).

Remember that the best plans are sure to change. It is equally important to be flexible as it is to plan well. Be prepared for changes in weather, schedules, and even to the original idea for the video. At all stages in the planning process it is helpful to revisit objectives and make sure that the script, storyboard, and shot selection best address the project's intent.

An often-overlooked aspect of pre-production is preparing the equipment. To avoid shooting delays, check that you have everything that you need and that it is in good working order. Replace or charge all of the batteries and have backups handy. Consider collecting additional microphones, tripods, extension power cords, lights, and duct tape. Becoming familiar with the equipment prior to the event avoids wasting valuable time for all involved (A. Foley, public presentation, Fall 2004).

Shooting Video

With good planning, the actual filming should be fairly straightforward. Remember that it is appropriate, in fact recommended, to reshoot, except when impossible such as with live events. It is acceptable to ask someone to repeat what they said in an interview. Below are basic guidelines for producing professional looking video for use in the classroom.

Composition & Framing

There are three basic types of shots: long, medium, and close-up. Which you use depends on what you are trying to convey with the shot. In general it is wise to vary between long shots (to give context) and closer shots (Click and Go Video, 2002). This will give your video a more professional look than one, long, unbroken shot.

A long shot frames a wide field of view including subjects and surroundings. Long shots establish the setting and location of what is to follow or may be used to cover broad acting involving several people. Use long shots sparingly as they do not allow for a lot of detail, particularly if you will be showing the video on a small screen. [For a video example see http://www.atomiclearning.com/cgi/atomicmovielog.cgi?movie=longshotx.mov]

Medium shots include your subject while still revealing some of the background. For a person, a medium shot would show them from the waist up. The greater detail in medium shots makes them more interesting than long shots. [For a video example see http://www.atomiclearning.com/cgi/atomicmovielog.cgi?movie=mediumshotx.mov]

Close up shots focus the viewer's attention on specific details and is useful for getting the most impact out of a shot. A close up of a person would include the shoulders to the top of the head. It is crucial to use a tripod when filming close up shots as the slightest camera motion will be distracting (*Composing Basic Camera Shots*, 2004). In fact, use a tripod whenever possible. A tripod will give a more stable shot with smoother panning, tilting, and zooming. [For a video example see http://www.atomiclearning.com/cgi/atomicmovielog.cgi?movie=closeupx.mov]

Whatever the shot, framing the main subject or action is also important. The standard means for obtaining balance in a shot is to organize the shot so the main elements of your shot are placed along lines that divide the screen into thirds (like a tic-tac-toe board) and particularly at the intersections of these lines. This is referred to as the “rule of thirds" (Click and Go Video, 2002) . For example, when shooting outdoors, try to put the horizon on the lower third or the upper third line depending on if the more interesting scenery is above or below the horizon. When shooting a person, put his/her head (when shooting the whole body) or eyes (when doing a close up shot) either on the left or right upper third intersection. To visualize how this works, watch interviews and segments on local news television shows to see how photographers frame their shots. [For a video example see http://www.atomiclearning.com/cgi/atomicmovielog.cgi?

movie=rulethirdsx.mov]

It is also important to consider the space around your subject. Leave enough room above and in front of the subject (if he/she is facing sideways) and avoid awkward cut off points such as the neck, knees, or wrists. If the subject is moving, be sure that the direction of their motion is consistent during a sequence of shots and give them plenty of lead space so it does not appear that they are walking off the screen. [For video examples see http://www.atomiclearning.com/cgi/atomicmovielog.cgi?movie=leadspace1x.mov and http://www.atomiclearning.com/cgi/atomicmovielog.cgi?movie=cutoffsx.mov

Bear in mind that the angle from where you film a subject can also convey meaning. Positioning the camera so that it is pointed upward may assign power or omniscience to the subject whereas shooting downward on a subject may make them appear weak, submissive, and powerless (A. Foley, public presentation, Fall 2004). Finally, if you are showing viewers how to do something, be sure to put the camera in the same position as the student or user so that the viewer's perspective is best for replicating the process (*Click and Go Video* , 2002).

Timing

When preparing and filming shots think about timing. Keep the shots just long enough to convey the message without boring the audience. Avoid static shots of more than a few seconds. Use cutaways to convey the passage of time. For example, to show the time it takes a cake to bake, show the cake being put in the oven, cutaway to the chef doing some other activity, and then cut back to the finished cake being removed from the oven. While the cake may take 30 minutes to bake, this sequence can be shown in about 30 seconds (Click and Go Video, 2002). While these shots will not be combined until the editing process, it is important to keep this in mind while planning and shooting.

Another timing consideration is more technical in nature. It takes a short amount of time for the tape in the camera to get up to speed. For this reason, you want to be sure the camera is recording at least 10 seconds before the action you wish to record takes place. It is also a good idea to let the camera record at least 10 seconds after the shot as well. This extra time will give you a little more flexibility when you are ready to edit (A. Foley, public presentation, Fall 2004).

Lighting & Audio

When it comes to lighting, a professional light kit is best but most schools do not have access to this equipment. Fortunately there are many ways to improvise. When no extra lighting is available, outdoors is better than indoors and a bright, overcast sky is best. However, be sure to watch for shadows and bright spots (A.

Foley, public presentation, Fall 2004).

If you have any control over the lighting, it is a good idea to bring a couple of gooseneck lamps. A soft light on each side of the camera or a soft sidelight and a front light will help eliminate most shadows. Make sure the subject appears clearly and distinctly from the background with no extra shadows.

Poor audio is the biggest mark of amateur video. Use a microphone that is appropriate for the specific shot to capture the best sound possible. Also, be aware of, and try to reduce, any background noise that may distract from the sound you are trying to capture.

Preparing your Subjects & Location

With all of the focus on equipment it is easy to forget about preparing what will be in front of your camera. Just as you should be familiar with your camera, you should also get to know the location you will be filming. This will help you plan where you want to place the camera and what extra equipment such as extension cords and extra lights you might want to bring.

Actors, interviewees, and other subjects should also be considered. Discuss what you hope to get out of shots ahead of time. If you are filming an interview or presentation, do a practice run to get an idea of what to expect such as pacing or large arm gestures. Encourage subjects to avoid wearing monotone colors or clothing with large patterns. Also, avoid reds and yellows, as they do not film well. And, of course, be sure to get a permission form from all who will appear in your video, particularly from the parents of students and other minors (Click and Go Video, 2002).

Special Considerations for the Internet

If you are planning on publishing on the Internet, there are several things you can do while filming to maximize the quality of your film and keep the memory size reasonable.

The simplest thing you can do is use little or no camera motion (panning and zooming). Because the window size for video on the web is considerably smaller than a TV screen, use as many close up shots as possible and avoid long shots, as the detail will be lost. Background detail can also eat up valuable memory so, if possible, film shots against a plain background.

After You Film

When you finish, or even as you film, be sure to catalogue your tapes. On the case jacket label exactly what you filmed on that tape along with the timing. For

example 0-7:32 – Interview with Dr. Smith, 7:35 - 18:18 – Sound demonstration. This will be helpful when it comes time to edit.

Editing

One of the features of digital video is the ease of editing. Numerous software packages are available ranging from free to thousands of dollars depending on the level of control and options needed. For most classroom purposes, free versions are more than adequate. All Macintosh computers released today come preloaded with *iMovie* (http://www.apple.com/ilife/imovie/). *Windows XP* also has a video-editing program, *Windows Movie Maker*, that comes pre-installed or can be downloaded for free (http://www.microsoft.com/windowsxp/downloads/updates/moviemaker2.mspx). For those who wish to take it a step further, *Adobe Premiere Elements* (http://www.adobe.com/products/premiereel/main.html) and *Final Cut Express* http://www.apple.com/finalcutexpress/) are excellent programs.

The first step to editing video is to capture (digitize or encode) footage and download it onto the computer. For most cameras today this requires a FireWire (IEEE 1394) cable. This comes standard on most Macs and many PCs. If you computer does not have a FireWire connection, it is inexpensive (less than $50) to purchase and install a FireWire card. For video, computers require sufficient memory--about 14 GB of hard disk space for each hour of video (J. Davis, public presentation, January 2005).

Most editing programs have several similar features such as a bin for storing and organizing video clips, a timeline for arranging the clips in order, and a preview window for viewing the clips and the edited video. They include a variety of transitions to use between clips, as well as special effects, and the ability to insert titles and additional audio such as music and sound effects (Martindale, 2002).

When editing, keep in mind the original goals and objectives of the project. Make sure that each clip, sequence decision, and effect addresses the message or content. The storyboard can help guide the editing, but remaining flexible is key.

Publishing

Once the video is edited it is time to publish. There are four basic video publishing outlets in order of increasing quality (and file size): web download, web streaming, CD, and DVD. Three factors to consider in deciding which to use are (1) how viewers will access the movie (online or via a disc), (2) the length of the video, and (3) if online, what speed will viewers be able to access the movie. If viewers will use a CD or DVD, then the file size or length of the movie is really the only consideration. CDs hold about 700 MB and DVDs hold about 4.7 GB.

Choosing to make a video available online allows viewers to download the entire movie before viewing. This can be time consuming, but if the video is being used in the classroom it can be downloaded ahead of time and viewers will not need to rely on the speed and availability of an Internet connection. On the other hand, streaming video is played directly off of the server on which it resides. The online limitation here is the viewer's Internet connection speed or bandwidth capacity. This allows download of longer movies without taxing computer file space. Streaming is an option but it does require special server software.

A decision must be made about the type of player viewers will use, and therefore the file type of the video. The most common are *RealMedia* (http://www.real.com), *QuickTime* (www.apple.com/quicktime/), *WindowsMedia* (www.windowsmedia.com/) and *Mpeg4* , which is compatible with the previous three. The choice of video editor may limit the choice of player. For example, *iMovie* only allows export as a *QuickTime* file, although there are numerous programs available that will convert between formats. For a detailed discussion of the different players visit http://www.clickandgovideo.ac.uk/players.htm.

In order to get a movie down to a reasonable size for publishing to the web, to a CD, or to DVD it must be compressed. Video is compressed using a codec. The word codec is a combination of coder and decoder. There are numerous codecs available that use an algorithm to reduce the memory file size by eliminating unnecessary audio and video data (Click and Go Video, 2002). For example, if the video includes a still shot for 20 frames, the codec reduces the memory needed for those 20 frames to one frame repeated 20 times so that about 19 frames worth of memory are eliminated.

When compressing video be sure to balance file size with quality so that the best quality version is accessible to viewers. For streaming video consider how your viewers will access the movie: via dial-up modem, cable, DSL, or a T1 line. A typical dial-up modem has a speed of 56 kbps (kilobits per second). That means that one minute of video can take no more than 420 kbps of memory (there are 8 bits in a byte). However, a viewer using a cable or DSL line can handle 255 kbps so one minute of video can take up to 1.9 MB. It is important that the video size not exceed these limits as it will appear jerky and out of sync.

There are three ways to control video file size: image compression, frame rate, and pixel dimension. Image compression depends on the type of codec. There are numerous codecs available and many editing software packages allow for codec choice. Some are more common than others but the best way to choose is to try several and see which looks best.

Frame rate is the number of frames shown per second. Your video was most likely recorded at 30 frames/second, however for viewing, 15 frames/second is often more than adequate. Again, it is best to try several different frame rates to see which works best.

Adjusting pixel dimension or window size is the most obvious method for reducing file size. DVD or CD will probably want a larger window size, such as 640 x 480, since download speed or memory is not an issue. For streaming or download off the Internet, 320 x 240 is quite acceptable. For short video with lots of detail a larger window size may work best. Again, try out several sizes to see which is most appropriate.

Once the video has been edited and encoded in a suitable format it is ready to publish. At this point the video can be burned to a CD or DVD or uploaded to the web for download or streaming, depending on the available publishing resources.

Conclusion

Whether teachers and students choose to create their own videos or simply show videos in class as a means to stimulate discussion or bring distant and difficult concepts to life, video is undeniably a powerful medium. Even the most technology-challenged teachers can use video to help integrate technology in their curriculum as mandated by the No Child Left Behind (NCLB) legislation and the National Education Technology Standards (NETS) using the strategies described above. Access to video on the Internet and new, affordable tools for creating video open up a whole new world of visual learning compared to the filmstrips of fifty years ago. Teachers have only to take advantage of these video resources to improve and enhance student learning.

About the Author

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Appendix: Free Video Resources Online

Annenberg/CPB
http://www.learner.org/view_programs/view.programs.html

Apple iLife - videos created by students
http://education.apple.com/education/ilife/

Apple Learning Exchange - includes video from a variety of sources including NASA http://ali.apple.com/

Atomic Learning's Video Storytelling Guide - includes the video examples used in this article. http://www.atomiclearning.com/storytellingindex.shtml

Educscapes - a collection of links to streaming video and other online resources
http://www.eduscapes.com/seeds/stream.html

eScreening Room - free, full length, documentaries
http://escreeningroom.com/

Internet Movie Archive
http://www.archive.org/details/movies

Real Guide News
http://news.guide.real.com/

United Streaming - requires a subscription but has a free 30 day trial
http://www.unitedstreaming.com/

Video Placement Worldwide
http://www.vpw.com/educational/

YouTube - watch and share video online
http://www.youtube.com/

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